

LEE -- 10/733,276  
Client/Matter: 040044-0307078

IN THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Canceled)
2. (Currently Amended) The method of claim [[4]] 8, wherein the first conductive line is formed of copper.
- 3.-7. (Canceled)
8. (Currently amended) A method of manufacturing a semiconductor device, comprising:
  - forming a first insulating layer on a semiconductor substrate;
  - forming a first conductive line by depositing a conductive material on the first insulating layer and selectively patterning the conductive material;
  - forming a second insulating layer by depositing an insulating material on top of the substrate including on the first conductive line;
  - forming a via hole and a trench by selectively patterning the second insulating layer to expose a certain portion of the first conductive line;
  - removing a natural oxide layer, formed on the first conductive line through natural oxidation of the first conductive line, by heat treating in an H<sub>2</sub>+CO gas atmosphere;
  - forming a metal barrier by depositing a metal layer on top of the substrate including in the via hole and on the trench;
  - forming a copper seed layer on top of the metal barrier; and
  - removing a natural copper oxide layer, formed on the copper seed layer through natural oxidation of the copper oxide layer, by heat treating in an H<sub>2</sub>+CO gas atmosphere.
9. (Original) The method of claim 8, wherein the heat treatment is performed at room temperature to 200° C.

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10. (Canceled)

11. (Previously presented) The method of claim 13, wherein the second conductive line is formed of copper.

12. (Canceled)

13. (Currently amended) A method of manufacturing a semiconductor device, comprising:

forming a first insulating layer on a semiconductor substrate;

forming a first conductive line by depositing a conductive material on the first insulating layer and selectively patterning the conductive material;

forming a second insulating layer by depositing an insulating material on top of the substrate including on the first conductive line;

forming a via hole and a trench by selectively patterning the second insulating layer to expose a certain portion of the first conductive line;

removing a natural oxide layer, formed on the first conductive line through natural oxidation of the first conductive line, by heat treating in an H<sub>2</sub>+CO gas atmosphere;

forming a metal barrier by depositing a metal layer on top of the substrate including in the via hole and on the trench;

forming a copper seed layer on top of the metal barrier;

removing a natural copper oxide layer, formed on the copper seed layer through natural oxidation of the copper seed layer, by heat treating in an H<sub>2</sub>+CO gas atmosphere;

depositing a conductive material for forming a conductive line on top of the substrate including on the metal barrier and the copper seed layer to sufficiently fill the via hole and the trench;

forming a plug and a second conductive line by planarizing the conductive material on the second insulating layer in order to expose the second insulating layer; and

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removing a natural oxide layer, formed on the second conductive line through natural oxidation of the second conductive line, by heat treating in an  $H_2+CO$  gas atmosphere.

14. (Original) The method of claim 13, wherein the heat treatment is performed at room temperature to 200° C.